

# What to do after needlestick injury?

## Jakie jest postępowanie po zakłuciu igłą?

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### Abstract

The aim of the study was to raise awareness amongst health care workers (HCW) on blood-borne disease transmission and facilitate the management of stressful situations after injuries contaminated with HIV, HBV, HCV, annually estimated at 2.1 million, 926,000 and 327,000, respectively. The literature was studied to analyze the post-exposure prophylaxis (PEP) and therapy for dental staff (dentist, dental hygienist, dental nurse and other HCW taking responsibility for the decontamination of instruments). The analysis included the following elements: first steps after injury at a dental office, referring to a qualified physician, laboratory testing according to HCW's and patient's immunological status, beginning of treatment regimen, time and types of follow-up examinations. PEP should be started immediately after needlestick injury and consist of: cleansing the injured site with soap and water, administering first aid, laboratory testing of the affected HCW and the source patient, referring the HCW to a physician experienced with infectious disease control and follow up examinations. If the physician decides that the risk for HIV exposure is high, the regimen of antiretroviral medications begins within 2 h after the incident. Deep injuries and injuries with visible blood increase the risk of transmission. The primary way to prevent the transmission of blood-borne pathogens is to avoid occupational blood exposure by staying focused during the procedures and using preventive measures. PEP would be much more effective if every medical office had written guidelines covering the prevention and management of needlestick injuries and the dental staff periodically attended educational seminars and training.

**Key words:** HIV, HBV, healthcare workers, needlestick injury, post-exposure prophylaxis

**Słowa kluczowe:** HIV, HBV, pracownicy służby zdrowia, zakłucie igłą, profilaktyka poekspozycyjna

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An exposure related to blood-borne viruses and bacteria transmission is defined as a percutaneous injury (e.g. needlestick injury or cut with a sharp object), mucous membrane splash or contact of non-intact skin (e.g. already injured) with blood or other potentially infectious materials (PIM).<sup>1,2</sup> This type of exposure can follow with transmission of some blood-borne viruses (like the Hepatitis B virus – HBV, Hepatitis C virus – HCV, Human immunodeficiency virus – HIV, Cytomegalovirus – CMV, Epstein-Barr virus – EBV and *Parvoviruses*) and bacteria (*Treponema pallidum*, *Yersinia sp.*, *Parasites sp.*, *Plasmodium sp.*),<sup>3</sup> which can cause some serious infections. Injuries contaminated with HIV, HBV and HCV are annually estimated at 2.1 million, 926,000 and 327,000, respectively,<sup>4</sup> and are an occupational hazard for health care workers (HCW) – that is, dental personnel, students and trainees, nurses, volunteers and other people not involved directly in patient treatment and care (e.g. responsible for the decontamination of instruments).<sup>2</sup>

Generally, needlestick injuries (NSI) are caused by a hollow needle (76.9%) and are visible as a superficial puncture with little bleeding (81.1%).<sup>5</sup> In studies conducted by Cleveland et al., most injuries were moderately deep (66%), followed by superficial (29%) and very deep (5%).<sup>6</sup>

Proper post-exposure prophylaxis (PEP) and treatment may significantly delay the development of the disease and reduce the transmission and mortality ratio. The risk of transmission of blood-borne viruses after NSI is estimated at 0.3% for HIV, 3% for HCV and 30% for HBV.<sup>3</sup> The risk of HIV transmission after mucous membrane splash amounts to 0.09%.

## Material and methods

The PubMed literature and Polish AIDS Society Recommendations were studied to analyze the post-exposure prophylaxis (PEP). The analysis included the following elements: first steps after injury at a dental office, referring to a qualified physician, laboratory testing according to the HCW's and patient's immunological status, beginning of treatment regimen, time and types of follow-up examinations.

## Results

The first steps after needlestick injury are: letting the wound bleed without sucking or squeezing, cleansing the injured site with soap and running water and administering first aid. If the mucous membrane splash (to eye, nose or mouth) occurred, the site should be thoroughly rinsed several times with water or saline solution. If the accident was work-related, the supervisor of the department should be notified. The next step is to sample the blood for HBV, HCV and HIV testing from the source patient. Before doing so, every conscious patient should provide

a written consent for it. When the source patient is adolescent: a) under 16 years old, the consent should be given by his legal guardian, b) between 16 and 18 years old, the consent should be given both by the patient and his legal guardian. It is recommended to ask the source patient in confidence about information which may affect PEP, such as history of antiretroviral therapy, the latest viral examination, lymphocyte CD4+ T level and indicator diseases. The affected HCW should be referred to a physician experienced with infectious disease control for examination. The aim of this examination is to assess the risk of transmission of the blood-borne diseases.<sup>3,6,7</sup> The results are summarized in Fig. 1.

## HIV

The risk of transmission depends on the serological status of the source patient and type of exposure. Deep injuries, injuries with visible blood caused by devices, large diameter needles, needles after i.m. or i.v. injection, and terminal illness in the source patient increase the risk of transmission.<sup>8</sup> If the source patient is HIV positive, antiretroviral medication should always be started within 2 h after the incident or 3 h when the risk of exposure is high. The details of PEP qualification according to Polish AIDS Society Recommendations are summarized in Table 1. If the antiretroviral therapy has been started, follow up

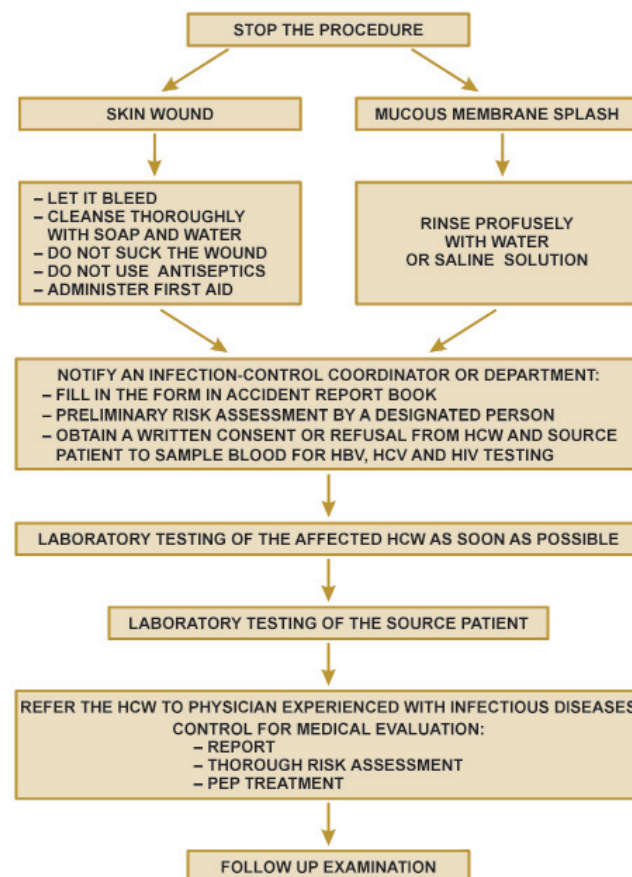


Fig. 1. First steps after exposure

**Table 1.** PEP for HIV according to Polish AIDS Society Recommendations

Exposition		Immunological status of the source			
		HIV (+)	immunological status unknown	source unknown	HIV (–)
Percutaneous	lower risk of transmission	3 antiretroviral drugs recommended	prophylaxis or 3 antiretroviral drugs not recommended if the source is a high risk of transmission	prophylaxis or 3 antiretroviral drugs not recommended if the source is a high risk of transmission	prophylaxis not recommended
	higher risk of transmission				
Mucous membrane splash	low volume of infectious fluid	3 antiretroviral drugs recommended	prophylaxis not recommended	prophylaxis not recommended	prophylaxis not recommended
	large volume of infectious fluid	3 antiretroviral drugs recommended	prophylaxis or 3 antiretroviral drugs not recommended if the source is a high risk of transmission	prophylaxis or 3 antiretroviral drugs not recommended if the source is a high risk of transmission	prophylaxis not recommended

examination should be performed after 2 weeks to check if the side effects of the therapy have occurred and after 2 and 4 months to investigate if HIV transmission happened (only if the risk of HIV transmission after NSI existed). PEP after work-related NSI is paid for by the employer.<sup>9</sup> The administration of zidovudine is recommended even to pregnant women infected with HIV, because of the 67% reduction of perinatal transmission.<sup>8</sup>

## HBV

Qualification to HBV prophylaxis depends on the serological status of the source patient and immunization of the HCW (Table 2). If the risk of HBV transmission occurred, follow up examinations are recommended after 6 months.

## HCV

Currently, a specific prophylaxis to HCV infection does not exist. After percutaneous exposure and mucous membrane or injured skin splash, follow up examinations

are recommended to assess HCV-RNA after 6–8 weeks or HCV antibodies and ALT after 6 months.

Follow up examinations are summarized in Table 3. These should be performed only if an experienced physician confirms a risky exposure. Otherwise, when the source patient is HIV(–), HBV(–) and HCV(–), these are not recommended.<sup>7</sup>

## Discussion

### Who sustains NSIs most often?

HCW are one of the professional groups most often exposed to NSI due to contact with patients, their blood and bodily fluids. Data collected in the UK between the years 2004–2013 revealed that injuries occurred in 81% of a group of HCW (doctors, nurses and healthcare assistants) and 65% occurred during clinical work.<sup>10</sup> In Poland there are around 27,000 NSIs per year just in hospitals, which means 20 injuries per 100 occupied beds yearly.<sup>11</sup> In Eu-

**Table 2.** PEP for HBV according to the Polish AIDS Society Recommendations

Immunological status of the exposed	Immunological status of the source		
	HBsAg (+)	HBsAg (–)	source unknown or his immunological status unknown
After or during HBV infection (HBsAg(+))	prophylaxis not recommended	prophylaxis not recommended	prophylaxis not recommended
Unvaccinated	course of 3 vaccinations with hepatitis B vaccine and 1 injection with hepatitis B immunoglobulin	course of 3 vaccinations with hepatitis B vaccine recommended	course of 3 vaccinations with hepatitis B vaccine
Vaccinated anti-HBs antibody level <10 IU/mL	single booster vaccination and 1 injection with hepatitis B immunoglobulin	prophylaxis not recommended	single booster vaccination
Vaccinated anti-HBs antibody level <10 IU/mL			
Vaccinated many times, poor response proved	2 injections with hepatitis B immunoglobulin with an interval of one month	prophylaxis not recommended	prophylaxis not recommended or 2 injections with hepatitis B immunoglobulin with an interval of one month if the high risk of transmission exists
Vaccinated, anti-HBs antibody level >10 IU/mL in the past	prophylaxis not recommended	prophylaxis not recommended	prophylaxis not recommended

Table 3. Follow-up examinations

Source person	Exposed person				
after exposure	after exposure	after 2 weeks (HIV PEP)	after 8 weeks	after 16 weeks	after 24 weeks
HBsAg	HBsAg	blood count			HBsAg
HCVAb	HBcAb	AST			Anti-HBc
HIVAb – IV generation test	HBsAb	ALT	HIVAb – IV generation test	HIVAb – IV generation test	HCVAb
	HCVAb	$\alpha$ -Amylase			ALT
	HIVAb – III or IV generation test	creatinine			
	pregnancy test – HIV PEP				

rope, this ratio ranges between 12–30 injuries, where it is presumed that 60–80% of all exposures are not recorded.<sup>11</sup>

## Risk factors for exposure

According to Prabhu et al., ‘years in practice’ is a statistically important factor amongst dental nurses.<sup>12</sup> In the group of dental nurses with working experience shorter than 6 years, 43.3% reported NSI, while those working longer than 6 years reported 19%. That can lead to a very important issue, that dental, medical and nursing students and doctors in training can be affected by NSI and, because of their limited experience, it can happen more frequently.

On the other hand, studies conducted by Cleveland and Cardo show that the lack of experience does not raise the risk of exposure to blood-borne pathogens.<sup>13</sup>

There are some groups of HCW for whom the risk of NSI is higher. These are the groups working in hospital wards (54.5%) and operating rooms (24.7%), where the procedures take longer, are more complicated and involve more HCW.<sup>14,15</sup> Chan et al. conducted a study where more NSI occurred in outpatient and inpatient clinics (33.6%) than in the operating room (25.2%).<sup>5</sup>

There is a significant difference between oral surgeons and general dentists. The serologic markers of HCV in the first group were higher (9.3%), than in the second (0.97%).<sup>16</sup> Also, the seroprevalence of HBV in the first group was higher (21.2%) than in the second one (7.8%).<sup>17</sup> This correlation may be related to the surgeons conducting many of the procedures after trauma, which can be the cause of trismus, unpredictable reflections, difficulty with access to the operating field, positioning of either the patient or oral surgeon, duration of the procedure and the use of sharp equipment (e.g. wires for intermaxillary fixation).<sup>18</sup>

In injury reports analyzed by Cleveland et al., exposures most often occurred during oral surgical (39%), restorative (21%), hygiene (15%) and “other” (25%) procedures.<sup>6</sup> Samaranayake and Scully confirm that procedures where the fingers are no longer visible to the operator are more risky for him.<sup>3</sup>

According to Chang et al., nurses were the largest group of HCW exposed to blood-borne pathogens (37.1%), the second were resident physicians (14%) and the third were interns (12.6%).<sup>5</sup> Studies by Nagao et al. also revealed that nurses sustain a NSI most often (72.2%), followed by doctors (19.7%) and clinical laboratory workers (3.5%).<sup>14</sup>

In studies conducted by Prabhu et al., common causes of NSI were: two-handed recapping and needle flexing.<sup>12</sup> According to Quinn et al., other very risky situations are: injecting medications (31%), placing sharps in a container (27%), administering fingerstick/heelstick (23%) and drawing blood (22%).<sup>19</sup> The long-term studies by Nagao et al. show that injuries occur more often after the use and before disposal of the sharps (45.9%), than during use (33.2%), during or after disposal (15.8%) and before use of the device (1.9%).<sup>14</sup> An interesting issue is that time pressure also seems to be an important factor in sharp injuries (24%).<sup>19</sup>

The next risk factor for NSI is conducting the procedure at night. According to Bali et al., exposure to blood-borne pathogens during procedures conducted at night was significantly higher (47%) than during the day (18%) in a group of trainee surgeons.<sup>18</sup> A similar correlation can be seen in a study performed on a group of medical students and residents, where injuries at night happened 1.5 times more often than during daytime.<sup>20</sup> The other issue connected to injuries sustained at night are: less available occupational health advice and fewer co-workers, which can cause delayed PEP.<sup>18</sup>

Although it is recommended to start PEP as fast as possible, studies conducted by Chang et al. reveal that the time between exposure to HBV and hepatitis B immunoglobulin (HBIG) injection is not relevant.<sup>5</sup> In the group of HCW who received an HBIG injection after more than 24 h, no cases of HBsAg-positive seroconversion were noted.

A study conducted by Bilski and Wysocki suggests that the knowledge of nursing personnel on the subject is inadequate.<sup>21</sup> The best known procedures were PEP for HIV, and the worst for HCV. Twenty one point six percent of nurses did not know anything about PEP for HIV, 25.6% for HBV and 29.6% for HCV. Amongst British junior doctors, only 76% were aware that PEP reduces the risk of HIV transmission. Although 76% of them were exposed to PIM one or more times, only 18% looked for advice about PEP. The most common reasons of neglecting PEP were: the patient of low risk of HIV (79%), lack of time (16%) and lack of knowledge (16%).<sup>22</sup>

Anxiety, stress, being in a hurry, fatigue and carelessness may also increase the risk of NSI.<sup>15,23,24</sup>

Studies conducted by Osazuwa-Peters et al. suggest that most often injuries occur due to a lapse in concentration (14.8%) and unexpected patient movement (12.3%).<sup>15</sup>



## Factors decreasing the risk of exposure

It is suggested that double gloving is one of the methods reducing the risk of exposure, but there is still no evidence to create recommendations for practitioners.<sup>25</sup> Wearing two pairs of gloves significantly reduces the risk of the inner gloves' perforation and is far safer for the operator than a single pair, but similar to one pair of thicker, orthopedic gloves.<sup>23,25</sup> Even more protection is ensured by triple gloving, knitted outer gloves and glove liners.<sup>25</sup> Most of the studies do not show a significant relationship between double gloving, lower dexterity of the operator and more perforations of gloves, but in a group of medical rescuers, double gloving significantly reduced dexterity.<sup>23,25</sup>

It is obvious that regular training on educational courses or in seminars reduces the risk of exposure and facilitates proper PEP. Amongst the educational interventions, a face-to-face training was the most effective form.<sup>26</sup>

One case-control study suggests that prophylactic taking of zidovudine reduces the risk of HIV infection by 81%.<sup>8</sup>

Every preventive measure used by HCW such as capping the ends of wire, a calm and procedure-focused attitude and precise operating reduce the risk of NSI.

## Other

Another important issue is that NSI also causes some psychological consequences. HCW who have sustained a NSI often feel anxiety, danger and guilt.<sup>27</sup> The best way to solve this problem is to follow the PEP procedure described above, which is called active coping. The other way of coping with psychological discomfort is a passive way, that is, hoping that no transmission of blood-borne viruses occur and relying on religion. This is often chosen because of fear of informing a supervisor.<sup>27</sup>

A really serious problem is that of neglecting to report NSI. According to Osazuwa-Peters' studies, 77% of young HCW did not report an exposure.<sup>15</sup> The most common reasons were considering the accident as unserious or being too busy.<sup>28</sup> In 1991 in the United States, a standardized tool for reporting exposures was created – the Exposure Prevention Information Network (EPINet).<sup>29</sup> It is already used in about 50 countries in North and South America, Asia, Australia, Africa and Europe.<sup>14,30</sup> With the aid of EPINet, it is possible to assess the procedures, devices, terms and places where exposures to blood-borne pathogens occur most often and to compare this data with other countries.<sup>30</sup> This information should lead to a better development of the equipment and procedures.

## Conclusions

Education about NSI and PEP should be started at the undergraduate level, because medical students are also at risk of injury.<sup>22</sup> Medical staff should regularly attend

educational seminars and training to refresh their knowledge and to make coping with a stressful situation after NSI easier. The primary way to prevent transmission of blood-borne pathogens is to avoid occupational blood exposures by staying focused during procedures and using preventive measures.<sup>1</sup> Medical offices should have a written policy on PEP and should familiarize new personnel with it. Supervisors should manage a non-punitive office reporting environment.

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